Efficiency analysis in wheat production in Turkey: the case of Konya Province

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Abstract

The aim of this study was to analyze the efficiency of wheat production activity in Konya province and to determine the factors affecting the economic efficiency. The data of the study were obtained from 165 wheat producers in Konya province in 2022. Data Envelopment Analysis was used to determine the efficiency of the wheat production. In the study, technical efficiency, pure technical efficiency, scale efficiency, allocation efficiency, and economic efficiency were calculated as 0.844, 0.959, 0.879, 0.913, and 0.875 respectively. It is determined that 76.97% of the enterprises have increasing returns to scale 20% have constant returns to scale, and 3.03% have decreasing returns to scale. In addition, according to the results of Tobit analysis, it was concluded that the amount of enterprise land, ownership structure of land, and irrigated land ratio positively affect economic efficiency in wheat production. According to the results of the study, it is concluded that the efficient use of inputs will contribute to an increase in the profit margin.

Keywords: Wheat production; DEA; Tobit regression; Efficiency.

1. Introduction

One of the basic needs of societies is the supply of food with sufficient nutritious quality. One of the most important problems created by the increasing population is that of quality nutrition (Güneş and Turmuş, 2020). Population growth increases the demand for food on a global scale. Ensuring adequate, balanced, and safe food, in other words food security, is a priority for societies to maintain healthy and strong lives, to develop economically and socially, to increase welfare levels, and to continue their existence under peace and security

(Buzbaş, 2010). Cereal crops such as wheat, maize and paddy are important agricultural products that can meet the food demand arising from population growth because of their high yield, adaptability to different climatic conditions and large cultivation areas (Wang et al., 2018).

Cereal grains, including wheat, maize and rice, are considered primary crops because they are the staple food for most of the world's population. By 2050, a 70-100% increase in cereal food supply is required to feed an estimated world population of 9.8 billion (Godfray et al., 2010). Although increasing production rates are often considered the solution to meet the growing demand, current production levels are projected to be insufficient to meet the targets (Ray et al., 2013). Furthermore, this problem is further compounded by a drastic reduction in the amount of productive and arable land available for growing these crops, which is expected to continue to decline in the future due to current agricultural practices (Hawkesford et al., 2013).

On the other hand, more than 820 million people in the world still suffer from hunger and this situation reveals how difficult it is to achieve FAO's goal of "ending hunger" by 2030 (FAO, 2019). When the world production of cereals, which are important for food security, is analyzed, 28% of the 2.7 billion tons of cereal produced are wheat. Wheat accounts for 42% of the 450 million tons of world grain trade (USDA, 2021). In Turkey, cereals are produced on 57.37% of the total 37 million ha of agricultural land and the production in this area reaches approximately 33 million tons. Approximately 59.75% of the production is wheat. It was determined that 48.25% of the total 33 million tons of cereal produced was used for human consumption, and wheat accounted for 91.11% of this consumption (TURKSTAT, 2020). When the area of cereals cultivated in Turkey and the amount of production are evaluated together, it is seen that cereals have an indispensable importance in the agricultural sector. Wheat has come to the forefront in the production of cereal products, and these products are highly used in human consumption. In addition, it can be said that cereal products, especially wheat, have great importance in terms of being used as animal feed, providing economic returns to producers and supplying raw materials to food industry organizations, as well as being the basic food in human nutrition.

Crises at regional, national, and global levels pose risks to the production and trade of wheat, which is important for food security. Wheat, which is important for human nutrition and the food industry, is the crop most affected by global disasters.

Many studies (Kibrom et al., 2023; Saboori et al., 2022; Pickson et al., 2023; Soylu, 2022; Yılmaz and Tomar, 2022; Demirbaş et al., 2017; Aydın Can et al., 2021, Kaypak, 2014) have investigate the effects of global disasters on food security. There are also studies examining the possible effects of global disasters on wheat production (Izzeldin et al., 2023; Mottalep et al., 2022; Demirbaş and Atış, 2005; Lin et al., 2022). In all these studies, it was emphasized that wheat is an important product in terms of food security.

To increase the contribution of the agricultural sector, which is an economic sector, to increase the welfare level of those working in the sector (Çelik and Bayramoğlu, 2007) and to ensure sustainable food security, agricultural enterprises need to use their production factors, such as natural resources, labor and, capital effectively.

Agricultural producers cannot use agricultural production factors at an optimum level due to inadequate working capital and lack of technical knowledge, and this situation negatively affects crop yields and thus farmer income. Therefore, studies are needed to determine the input use levels of farmers for each product and to reveal which inputs should be used and at what rate (Gündoğmuş, 1997).

Because of growing populations, scarce and insecure access to water and fertile land, and a lack of infrastructure that hinders market linkages, wheat-producing enterprises are facing increasing pressures. These threats to that production must increase to meet global food demand. Indeed, since wheat is the staple food for more than half of the world's population, the economic efficiency of wheat-producing enterprises needs to be increased (Mala and Akbay 2022).

In this study, the efficiency of wheat enterprises in the Konya province, where the wheat production is the most intensive in Turkey, was measured. In addition, the factors affecting the economic efficiency in wheat production were revealed. Within the scope of the study, we attempte to determine whether the production factors used in wheat production by agricultural enterprises are used effectively.

2. Literature Review

Konyalı and Gaytancıoğlu (2008) number the amount of inputs used by the districts in wheat production in the Thrace region. Data envelopment analysis was applied to the data obtained from 262 questionnaires in 131 villages. According to the results of the research, while it was determined that most of the districts in the research area used excess inputs, it was determined that only in Çerkezköy and Çorlu districts, producers used inputs effectively.

Masuda (2016) evaluated the regional suitability of ecological efficiency of wheat production in Japan using data envelopment analysis. According to the research findings, it was found that reducing water-borne eutrophication (pollution caused by increased nutrient levels) and overuse of nitrogen fertilizer would improve the eco-efficiency of wheat production. It was also found that abandoning of rice production as a second crop would increase productivity.

Alemdar and Ören (2006) examined the technical efficiency of wheat farmers in the southeastern Anatolia region of Turkey and the factors affecting the efficiency. While the technical efficiency scores of the analyzed enterprises varied between 0.38 and 1.00, the average technical efficiency score was 0.83.

Javed et al. (2008) examined the technical, allocation, and economic efficiency of wheat production in the Punjab region of Pakistan. They calculated that the average technical efficiency score was 0.83, allocation efficiency was 0.47, and economic efficiency was 0.40.

Sohail et al. (2012) examined the efficiency of wheat production in the Sargodha district of Pakistan using data envelopment analysis with farm-level data. The average technical efficiency coefficient of the analyzed farms was calculated to be 0.87, and they found that the distance of the farm to the market and farm size negatively affected the efficiency.

Aydın et al. (2022) measured the efficiency of wheat production activity of farms with and without soil analysis using data envelopment analysis. While the average technical efficiency of the enterprises having soil analysis was calculated as 0.90, the technical efficiency scores of the enterprises not having soil analysis were calculated as 0.86. According to the results of the research, it was determined that the enterprises that have soil analysis are more efficient in terms of input use than the enterprises that do not have soil analysis.

3. Material and Method

The data used in the study belong to the production period of 2022 and were obtained through a questionnaire survey. The questions in the questionnaire were compiled from similar studies, and the economic efficiency of wheat production was analyzed through the survey. The region surveyed within the scope of the study is Konya province, and the agricultural enterprises in this region constitute the total population. The proportional sampling method was used to determine the sample from the population. Therefore, the following formula was used. In addition, 99% confidence limits and 10% margins of error were used for sample determination.

N= Number of Units in the Population

p= the proportion of the studied unit in the population. q = 1-p

D2= d/t d = acceptable error t = t value for a given confidence interval

$$n = \frac{N(p.q)}{(N-1)D^2 + (p.q)}$$

The p and q values in the formula are 0.50. These ratios give the maximum number of samples. Increasing the number of samples will increase the representativeness of the population (Oğuz and Karakayacı 2017). Using these values, 165 managers of wheat-producing agricultural enterprises in the research region were surveyed.

In the study, first, we aimed to determine the economic efficiency of wheat-production activity. For this purpose, Data Envelopment Analysis (DEA) was used to determine the ability of wheat-producing enterprises to reach the maximum production amount with a certain amount of input. Data envelopment analysis is an analysis method that guides managers and decision-makers on what should be done to improve the efficiency of relatively inefficient decision-making units. In this context, Farrell's input-oriented efficiency measures were used in this study because operators will need to check the efficiency of the inputs rather than the outputs. A multi-input-single output model was created for each enterprise group. The input-oriented economic efficiency for each enterprise was obtained by using the following linear programing model.

$$\lambda xi\ W_i * X_i *$$
$$-y_i + Y\lambda \geq 0$$
$$X^i * -X\lambda \geq 0$$

λ≥0 the formula;

Wi: Vector of input prices for the enterprise in ranking i,

Xi∗∗: Input quantity cost minimization vector calculated for enterprise ranked i, yi: output level,

λ: denotes the vector of constants. Among the values obtained, Xi∗ represents the efficiency value between 0 and 1 for enterprises ranked i. A Xi∗ value equal to 1 indicates that the enterprise is on the frontier or has technical efficiency according to the definition of Farrell (1957). In inefficient enterprises, the value of Xi∗ will be less than 1. By solving the problem for each enterprise in the sample, N numbers of Xi∗ are obtained (Coelli 1998). The efficiency value of any enterprise varies depending on the other economic and technological units included in the analysis and socio-economic factors.

During the efficiency analysis, multivariate statistical methods were used to determine the technical and economic factors of resource utilization and operational efficiency. With the help of the DEAP 2.1 package program developed by Coelli (1995), estimates of efficiency measurement were made.

After determining the efficiency scores of each enterprise, a Tobit regression model was established to determine the factors affecting the economic efficiency. The Tobit regression model developed by Tobin (1958) was first used to determine the relationship between household expenditures and income level. In the study, the expenditures of household expenditures were assumed to be zero when they did not exceed a certain income level. In this study, unobservable units were accepted as zero or unobservable variables were not included in the model. Within the scope of this study, the economic efficiency results of each wheat producing agricultural enterprise were included in the model as the dependent variable and the efficiency results of the enterprises with an efficiency level below 0.90 were accepted as 0 and included in the model. Thus, with the censored tobit regression model, unobservable-dependent variables take the value of zero, whereas the values of the corresponding independent variables can be observed. In this study, 94 enterprises had economic efficiency results below 0.90 and therefore, the efficiency results of these enterprises were included in the model as "censored data".

Restricted-dependent variables can also be estimated using the tobit model and probit model. However, the parameters estimated with the tobit model are more efficient than those estimated with the probit model (Üçdoğruk et al., 2001). For this reason, the tobit model is used in this study, and its general representation is as follows (Greene 2003).

$$Y^{*}=bX+m$$

$$Y=Y^{*} \text{ If } Y^{*}>0$$

$$Y=0 \text{ if } Y^* \leq 0$$

In the equation, Y* is the unobservable (latent) variable, b is the (k x k) dimensional parameter vector, X is the (k x k) dimensional vector of independent variables, m is the error term, and Y is the observable variable (Akgüngör et al., 1999). In the equation to be prepared within the scope of the Tobit model, economic efficiency results were taken as the dependent variable and the independent variables were determined as operator age, operator education level, land holding, capital amount, insurance, agricultural income, land ownership structure, irrigated land ratio, animal presence, contracted production, and number of plots.

4. Results and Discussion

The descriptive statistics of the variables used in the efficiency analysis are given in Table 1. In the research area, it was calculated that on average, the enterprises obtained 2018.05 $ ha-1 income from wheat production activity. During the wheat production activity, it was determined that they spent 103.72 $ ha^{-1} labor, 327.23 $ ha^{-1} machine, 157.96 $ ha^{-1} seed, 385.07 $ ha^{-1} fertilizer and 83.51 $ ha^{-1} water costs.

Table 1: Descriptive statistics of variables used in efficiency analysis

Data envelopment model	Mean	Std. Deviation	Min	Max.
GDP ($ ha^{-1})	2018.05	292.45	1444.04	2527.08
Labor costs ($ ha^{-1})	103.72	11.98	45.17	147.22
Machine costs ($ ha^{-1})	327.23	34.15	258.72	598.07
Seed costs ($ ha^{-1})	157.96	22.49	114.32	216.61
Fertilizer costs ($ ha^{-1})	385.07	58.98	270.16	560.17
Water cost ($ ha^{-1})	83.51	7.42	72.20	96.27

In this study, the coefficient of technical efficiency with variable returns to scale varied between 0.800 and 1, but the average was calculated as 0.959. This result shows that inefficient enterprises can reduce their inputs by 4.1% without a decrease in output. The coefficient of technical efficiency with constant returns to scale was found to be 0.844 and the scale efficiency, which indicates whether the enterprises are at the optimal scale, was found to be 0.879.

The resource utilization efficiency in the analyzed enterprises varied between 0.743 and 1, and the average resource allocation efficiency was found to be 0.913. This value shows that enterprises spend 8.7% more than the minimum cost composition.

The economic efficiency varied between 0.726 and 1, and the average economic efficiency was determined to be 0.875. This value shows that other economically inefficient enterprises should reduce their operating costs by 12.5% to reach the level of economically efficient enterprises (Table 2).

Table 2: Descriptive statistics of the efficiency scores

Efficiency measurements	Mean	Std. Deviation	Min	Max
Technical efficiency (CRS)	0.844	0.116	0.612	1.00
Pure technical efficiency (VRS)	0.959	0.047	0.800	1.00
Scale efficiency	0.879	0.108	0.667	1.00
Allocation efficiency	0.913	0.058	0.743	1.00
Economic efficiency	0.875	0.062	0.726	1.00

It was determined that 20% of the analyzed farms had constant returns to scale, 3.03% had decreasing returns to scale, and 76.97% had increasing returns to scale (Table 3). Aydın et al. (2022) found that 33.33% of wheat-producing enterprises had constant returns to scale, 5% had decreasing returns to scale, and 61.67% had increasing returns to scale.

Table 3: Scale efficiency analysis results

Return to the scale	N	%
Constant returns to scale	33	20.00
Diminishing returns to scale	5	3.03
Increasing returns to scale	127	76.97
Total	165	100.00

It was determined that the gross production value obtained by enterprises with increasing returns to scale was lower than those with decreasing returns to scale and constant returns to scale. While the labor and irrigation costs of the enterprises with decreasing returns to scale were higher than those of the enterprises with increasing and constant returns to scale, seed and fertilizer costs were lower. According to the results of the analysis of variance, it was determined that gross production value (F=44.933, p=0.000), fertilization costs (F=2.356, p=0.098) differed according to the return to scale groups, whereas labor costs, irrigation costs, seed costs, and machine costs did not differ according to the return to scale groups.

Table 4: Comparison of enterprises in terms of Return to Scale

	GDP ($ ha^{-1})	Labor ($ ha^{-1})	Machine ($ ha^{-1})	Seed ($ ha^{-1})	Fertizer ($ ha^{-1})	Water ($ ha^{-1})
Constant returns to scale	2319.45a	104.20	324.67	155.98	404.77a	82.96
Diminishing returns to scale	2436.82b	105.28	317.64	145.19	375.57a	87.85
Increasing returns to scale	1923.29b	103.53	328.27	158.98	380.32b	83.48
Total	2018.08	103.72	327.23	157.96	385.06	83.51

The classification of the analyzed enterprises according to their technical efficiency is given in Table 5. It was determined that 43.6% of the enterprises were technically fully efficient. In addition, 20% of the enterprises were found to be efficient, 23.6% were found to be less efficient and 12.7% were found to be technically inefficient. It was determined that 20% of the enterprises operate at an optimal scale, i.e, their scale efficiency scores are equal to 1. In addition, 9.1% of the enterprises were found to be operating close to the optimal scale.

Table 5: Classification of enterprises based technical efficiency

	Technical efficiency (CRS)		Pure technical efficiency (VRS)		Scale efficiency	
	N	%	n	%	n	%
Fully effective (TE=1)	21	12.7	72	43.6	33	20.0
Effective (0.95≦TE<1)	14	8.5	33	20.0	15	9.1
Less effective (0.90≦TE≦0.949)	36	21.8	39	23.6	48	29.1
İneffective (TE≦0.899)	94	57.0	21	12.7	69	41.8
Total	165	100.00	165	100.00	165	100.00

The classification of enterprises according to resource allocation efficiency and economic efficiency is given in Table 6. According to the results obtained, 1.2% of the enterprises were found to be fully efficient, 30.9% were found to be efficient, 33.3% were found to be less efficient in terms of resource allocation efficiency, and 34.5% were found to be inefficient in terms of resource allocation, that is, they produced with the wrong input combination.

It was determined that 1.2% of the enterprises were fully efficient in economic terms, that is, they realized the production with the minimum cost input combination. While 9.7% of the enterprises were found to operate efficiently, 27.9% were found to operate less efficiently, 61.2% were found to operate inefficiently in economic terms.

Table 6: Classification of enterprises according to resource allocation efficiency and economic efficiency

	Allocation efficiency		Economic efficiency	
	N	**%**	**n**	**%**
Fully effective (TE=1)	2	1.2	2	1.2
Effective (0.95≦TE<1)	51	30.9	16	9.7
Less effective (0.90≦TE≦0.949)	55	33.3	46	27.9
İneffective (TE≦0.899)	57	34.5	101	61.2
Total	165	100.00	165	100.00

The descriptive statistics of the variables used in the Tobit model are given in Table 7. The age of the owner was 48.06, the average education was 2.19, the number of parcels was 3.69 and the land size was 28.69 ha^{-1}. It was determined that 73.23% of the enterprises had property land and 53.61% had irrigated land.

Table 7: Descriptive statistics of variables used in the Tobit model

Tobit model	Mean	Min	Max	Std. Deviation
Age of the owner (years)	48.06	19.00	90.00	12.66
Education level of the business owner (1: Primary school, 2: Secondary education, 3: High school, 4: Higher education)	2.19	1.00	4.00	1.16
Land size (ha)	28.69	1.00	172.50	23.67
Capital (TL)	2504452.15	141475.00	30957600.00	3845329.87
Insurance status (1:Yes, 2:No)	1.72	1.00	2.00	0.45
Agricultural Income (TL)	542750.99	-82710.92	4591672.78	719499.62
Proportion of owned land (Share in total land)	73.23	0.00	100.00	32.19
Proportion of irrigated land (Share in total land)	53.61	0.00	100.00	46.04
Animal Husbandry Activity (1:Yes, 2:No)	1.51	1.00	2.00	0.50
Contract production (1:Yes, 2:No)	1.56	1.00	2.00	0.50
Number of Parcels (Number)	3.69	1.00	8.00	2.09

In the agricultural sector, personal factors, demographic, economic, and social characteristics of operators, and environmental factors affect the economic efficiency of wheat production (Hazneci and Ceyhan 2016). In this context, a tobit regression model was established by including these factors in the model and the factors affecting economic efficiency in wheat production were determined. As a result of the modeling, only one-sided tobit model with left-hand censoring and right-hand censoring was used and 94 enterprises were identified as censored. Since these enterprises have low efficiency (efficiency<=0.90), the model was established as one-sided. Within the framework of the model, it was determined that there was a negative effect between the age of the operator, livestock and number of plots and the economic efficiency of wheat production. As a matter of fact, the high tendency of young operators to innovate makes a positive contribution to production costs. In addition, in today's conditions where specialization is important, it can be said that dealing with more than one production activity in the agricultural sector reduces the profitability and efficiency of enterprises. As a matter of fact, this situation has been emphasized in many studies and it is thought that economic efficiency will increase with an increase in the degree of specialization. A similar situation is also valid for the number of parcels indicator. It is known that an increase in the number of parcels will increase the cost of production. Because of the test statistics, a negative effect of the number of parcels on economic efficiency was determined.

The indicators that have a positive effect on the economic efficiency of wheat production are the operator's level of education, land holding, capital amount, insurance coverage, agricultural income, contracted production, ownership rate and irrigated land ratio. As the level of education of the operators increases, their level of awareness and consciousness increases. Therefore, their adaptation process to innovations and technologies is shorter and contributes to increased efficiency. To accelerate the process and increase efficiency, training and extension classes should be formed according to regions, films and brochures should be prepared, and face-to-face interactions between research centers-universities-agricultural enterprises should be increased. Indeed, studies have shown that wheat enterprises with high access to agricultural information are more resilient to potential risks (Urquhart et al., 2019, Nooghabi et al., 2022).

It can be said that economic efficiency will increase with an increase in the amount of capital and agricultural income, which are economic indicators. In fact, the increase in agricultural income and capital per unit is among the factors indicating economic profitability. In recent years, the instability in wheat prices has increased due to many environmental, economic and political crises, especially climate change, and the fluctuations in wheat prices were exacerbated by the 2022 Russia-Ukraine crisis. The rate of increase in wheat prices has decreased in line with the policies implemented, especially in the Grain Corridor. Therefore, because of all these factors, local wheat prices have increased and the agricultural income of the operators has increased. Thus, it can be said that the increased agricultural income at the end of the harvest will increase the economic efficiency of the enterprises as it is the determinant of the next production period. The most important strategy used to prevent price fluctuations is contract farming. Contract farming benefits rural development by increasing the welfare of households through price regulation (Singh 2002, Bijman 2008, Bellemare 2010, Sharma 2016). However, in Turkey, contract farming in wheat production is only practiced between seed enterprises and firms. For this reason, although contract farming is not widespread in wheat production, it can be said that contract farming has a positive effect on ensuring economic efficiency (0.012).

In addition to price fluctuations, the most important strategy to be implemented against climate change affecting wheat production is insurance. In recent years, there has been a significant increase in the implementation of compulsory agricultural insurance in order to benefit from financial support systems such as subsidies, grants, etc. These agricultural insurances are important in terms of protecting both producer income and supply-demand balance (Mateos-Ronco and Izquierdo 2011, Khorramdel et al., 2018, Alinejadian-Bidabadi et al., 2021). In the scope of the study, a positive relationship was found between insurance and economic efficiency (0.026) and it is used as an important strategy against possible natural and agricultural risks.

Structural factors affecting economic efficiency are enterprise land (da), ownership structure and irrigated land ratio. Accordingly, enterprise land (0.000), ownership structure (0.000) and irrigated land ratio (0.004) have a positive effect on economic efficiency. In case of an increase in enterprise land, the yield and profitability obtained from unit area in large-scale agricultural holdings are higher and this increases economic efficiency. On the other hand, the efficiency of enterprises decreases due to the ownership problem, which is an important problem in Turkey's agricultural lands. With the ownership problem, land scales shrink or cannot be operated fully efficiently. In addition, the presence of irrigated land, which is an important factor in increasing economic efficiency, has been increasing in Turkey in recent years. In recent years, the presence of irrigated land in Turkey has increased 1.5 times and support for rural development is provided by various institutions and organizations (Bayar 2018). As a result, the yield and profitability obtained with the spread of irrigated agriculture in rural areas increase simultaneously and contribute to development.

Table 8: Tobit analysis results: Factors affecting economic efficiency

Variables	Coefficient	Std. Error	p
Fixed	1.424059***	0.371646	0.000
Age of the business owner	-0.0163097***	0.004323	0.000
Duration of education of the business owner	0.0926409**	0.039813	0.021
Land size	0.0008062***	0.000193	0.000
Capital	5.81e-08**	2.59e-08	0.026
Insurance Status	0.169529*	0.090097	0.062
Agricultural Income	1.46e-07**	6.47e-08	0.026
Property	0.0051917***	0.001444	0.000
Proportion of irrigated land	0.0028817**	0.000982	0.004
Animal presence	-0.1645883*	0.088830	0.066
Contract production	0.418933**	0.090316	0.012
Number of parcels	-0.0407652*	0.023198	0.081
Likelihood	-68.54534		

* significant at 10% probability level, ** significant at 5% probability level, *** significant at 1% probability level.

5. Conclusion

In this study, the efficiency analysis of wheat producers, which are intensively produced in Konya province, was carried out and the factors affecting the efficiency were determined. The technical efficiency coefficient was determined as 0.844 and it was determined that the producers were at a good technical level. Technical efficiency and scale efficiency scores are almost the same and it is concluded that technical inefficiency is caused by inefficiency in input utilization and scale inefficiency.

In wheat production, resource allocation efficiency was 0.913 and economic efficiency was 0.875. It was concluded that enterprises spend 8.7% more than the minimum cost input combination and that economically inefficient enterprises should reduce their operating costs by 12.5% in order to reach the level of similar and economically efficient enterprises.

In addition, social and economic factors affecting the economic efficiency of wheat producing enterprises were examined and it was determined that the age, livestock assets and number of parcels of wheat producing enterprises have a negative effect on the economic efficiency of wheat production, while the educational level of the operators, land assets, capital amount, insurance status, agricultural income, contracted production, ownership ratio and irrigated land ratio have a positive effect on the economic efficiency of wheat production. Accordingly;

- Developing resistant varieties with low water requirements and high climate tolerance
- Changing sowing-harvesting patterns
- Provide low-interest loans, establish income stabilization funds, develop pricing and purchase guarantees and agricultural insurance schemes to increase the resilience of operators
- To organize training programs by establishing an "Agricultural Extension Coordinatorship" within the government
- Expand contract production of strategic staple crops, especially wheat, and ensure supply-demand balance through production/consumption planning.

In addition to these policies, supportive government policies (e.g. providing access to new technologies, preparing the necessary irrigation and consolidation infrastructure, expanding contract production, implementing modern irrigation methods, and increasing well inspections in drought-prone areas) have the potential to reduce socioeconomic vulnerability.

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